VISIT…

Chapter 9

Lubricating Greases*

Today's new-generation greases are expected to do much more than lubricate. They must meet a wide range of demanding performance requirements, such as:

- Long, trouble-free service life, even at high temperatures
- Rust and corrosion prevention
- Dependable, low-temperature start-up
- Resistance to slingoff and water washoff
- Conformance to increasingly stringent industry and governmental standards

Lubricating greases consist of a lubricating oil, a thickener and one or more additives. The thickener is responsible for the characteristics of the grease (Table 9-1 and Figure 9-1). Complex greases generally have a higher drop point, are more resistant to oxidation, liquids and vapors. Synthetic thickeners are most resistant to temperature. Extensive testing is done to verify properties, Figure 9-2.

The *advantage* of a lubricating grease over an oil is that it remains at the friction point for a longer time and that less effort is required in terms of design.

Its *disadvantage* is that grease neither dissipates heat nor removes wear particles from the friction point.

Application

Lubricating greases are used to meet various requirements in machine elements and components, including

- valves
- seals
- springs
- gears
- threaded connections
- plain bearings
- chains
- contacts
- ropes
- switches
- screws
- rolling bearings
- shaft/hub connections

*Source: Exxon Company, USA, Houston, Texas (Publication DG-3) and Klüber Lubrication North America, Londonderry, New Hampshire.

Copyright © 2000 The Fairmont Press, Inc.

Table 9-1. Impact of thickener on the properties of greases. (Source: Klüber Lubrication North America, Londonderry, New Hampshire.

Thickener	Service temperature range (°C)		Drop point DIN ISO 2176 (°C)	Water resistance	Stability at high pressure	Preferred applications
	min. oil	synth. oil				
Aluminum	-20 to 70	—	120	good	satisf.	Gears, valves (coke gas)
Calcium	-30 to 50	—	100	very good	good	Labyrinth seals under impact of water
Lithium	-35 to 120	-60 to 160	170/200	good	satisf.	Rolling bearings, contacts
Sodium	-30 to 100	—	150/170	unsatisf.	satisf.	Gears
Al complex	-30 to 140	-60 to 160	>230	good	satisf.	Rolling and plain bearings (plastic bearings), small gears
Ba complex	-25 to 140	-60 to 160	>220	very good	very good	Rolling bearings, valves, plain bearings subject to mixed friction
Ca complex	-30 to 140	-60 to 160	>190	very good	very good	Rolling bearings, seals (high-speed grease), chain grease
Li complex	-40 to 140	-60 to 160	>220	good	satisf.	Rolling bearings, couplings
Na complex	-30 to 140	-60 to 160	>220	satisf.	satisf.	Rolling bearings (subject to vibration, tribocorrosion)
Bentonite	-40 to 140	-60 to 180	none	good	satisf.	Valves (silicone base for high vacuum), gears, contacts
Polyurea	-30 to 160	-40 to 180	none	good	satisf.	Rolling bearings (long-term and lifetime lubrication of bearings i.e., sealed bearings)
PTFE	—	-40 to 260	250	good	good	Rolling bearings, valves subject to aggressive media

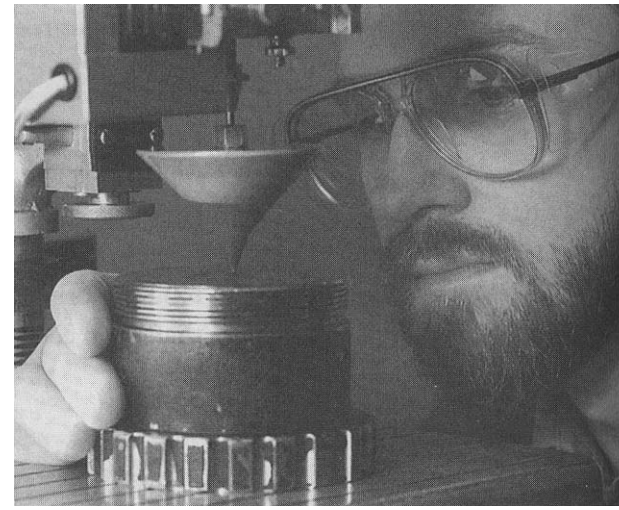

Figure 9-1. Greases are graded according to their consistency, i.e., resistance to deformation under the application of force. Consistency is measured with a penetrometer—shown here—and is reported as the tenths of a millimeter that a standard cone will penetrate the test sample under conditions prescribed by ASTM D 217. The softer the grease, the higher the penetration number.

Copyright © 2000 The Fairmont Press, Inc.

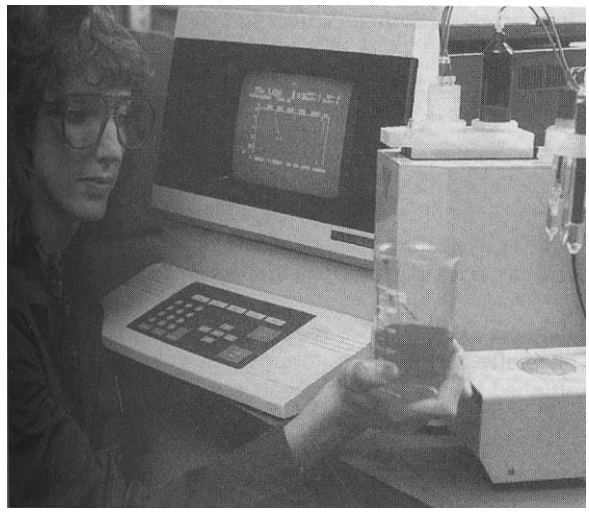

Figure 9-2. A technical specialist at Exxon's Pittsburgh grease plant measures the acidity/alkalinity of grease components on a titrator.

Lubricating greases can also fulfill various tasks apart from being effective against friction and wear. They may be required to

- be rapidly biodegradable
- conduct electric current
- be resistant to ambient media
- protect against corrosion
- be neutral to the materials involved
- be a low-noise grease
- comply with food regulations
- be resistant to temperatures
- be able to carry high loads

Other primary or secondary grease applications include:

- running-in grease
- fluid grease
- adhesive grease
- smooth running grease
- high-speed grease
- grease for underwater applications
- thermally conductive grease

Tribotechnical Data

A lubricating grease is characterized by its tribotechnical data, Table 9-2. It permits lection of an adequate lubricant to suit the special requirements of an application (e.g., in terms of temperature, load, speed).

Greases are classified (graded by NLGI, the National Lubricating Grease Institute. For details, refer to the entry "Grease Classification," in Chapter 3.

Copyright © 2000 The Fairmont Press, Inc.

Table 9-2. Tribotechnical data of lubricating greases. (Source: Klüber Lubrication, North America, Londonderry, New Hampshire.

Characteristics	Test	Notes
Base oil/ thickener		Both raw materials provide information about the possible behavior of a lubricating grease. However, only the chemico-physical and the mechano-dynamic properties are characteristic of a grease's actual performance.
Density	DIN 51 757	The amount of lubricant required for a certain friction point is generally indicated by volume. The volume in mm^3 multiplied by the density equals the quantity of lubricant in g required for the friction point.
Base oil viscosity	DIN 51 561	Thin-bodied base oils ≤ 46 mm/s are preferred for increased speeds, low loads and low surface roughness. Thick-bodied base oils—220 mm/s are preferred for low speeds, high loads and/or increased surface roughness.
Color		The color is not a performance characteristic. It is usually determined by the raw materials and additives. Graphite and MoS_2 greases, for example, are black.
Drop point	DIN ISO 2176	Even though the drop point is not indicative of the upper service temperature, it should be at least 40°C above this limit.
Service temperature range		An adequate relubrication interval can be achieved within the specified range. Service temperatures are indicated on the basis of measurement and testing procedures as well as practical experience.
Speed factor (n • dm)		The speed factor is important for lubricating greases used in rolling bearings. It takes into consideration the varying internal friction of the base oil/thickener combination. If a lubricating grease used in another field of applications has been attributed a certain speed factor, it is also suitable for rolling bearings.
Worked penetration	DIN ISO 2137	Measuring the worked penetration provides information about a grease's consistency, i.e. whether it is soft or hard.
Consistency	DIN 51 828	The classification of greases in NLGI grades is a simplified classification in terms of worked penetration.
Apparent viscosity		The apparent viscosity (measured in mPa • s) is the same as the lubricant's internal friction. Kluber has classified the apparent viscosity in 5 classes. Class EL (extra light) characterizes a smooth running grease suitable for applica-

(Continued)

Copyright © 2000 The Fairmont Press, Inc.

Table 9-2. (Continued)

Characteristics	Test	Notes
		tions with an extremely low torque. If the measured value overlaps with class L (light), the value is indicated as EUL.

VISCOSITY GRADES

Viscosity class	Apparent viscosity (mPa•s)	Explanation
EL	≤ 2000	Extra-light lubricating grease for extremely low torques, e.g., smooth running grease
L	2000... 4000	Light lubricating grease for low torques or high speeds in rolling bearings, e.g., high-speed grease
M	4000... 8000	Medium lubricating grease for standard requirements at all grease lubrication points
S	8000... 20 000	Heavy lubricating grease for high loads or fluids, e.g., high-pressure or sealing greases
ES	≥ 20 000	Extra-heavy lubricating grease for high torques or increased securing effect, e.g., valve or optical greases

CONSISTENCY CLASSES

Consistency class DIN 51 818 (NLGI)	Worked penetration DIN ISO 2137 (0.1 mm)	Texture	General application
000	445... 475	fluid	mainly for gear lubrication
00	400... 430	almost fluid	
0	355... 385	extremely soft	
1	310... 340	very soft	lubrication of rolling and plain bearings
2	265... 295	soft	
3	220... 250	medium	
4	175... 205	hard	sealing and barrier grease for labyrinths
5	130... 160	very hard	and valves
6	85... 115	extremely hard	

(*End*)

Copyright © 2000 The Fairmont Press, Inc.

Incompatible Greases

Incompatibility occurs when a *mixture of greases* exhibits properties or performance significantly inferior to those of either grease before mixing. Some grease bases are intrinsically incompatible. Incompatibility may affect several performance properties such as lower heat resistance; change in consistency, usually softening; a decrease in shear stability or a change in chemical properties such as the formation of acids. (Ref. 1)

Electric motor bearings are often furnished with polyurea-type greases. Polyurea greases exhibit excellent corrosion protection and are thus well suited for equipment in storage. However, when mixed with lithium-base greases—typically used by operating facilities because of their attractive all-around properties—the grease mixture may give inferior protection than either grease by itself. Experience shows that six months is about the limit for the life of some grease mixtures.

Although Table 9-3 shows that certain greases are indeed compatible, mixing should be avoided. Refer to the chapter on Electric Motor Lubrication for further information.

Table 9-3. Grease compatibility chart.

	Aluminum Complex	Barium	Calcium	Calcium 12-hydroxy	Calcium Complex	Clay	Lithiulm	Lithium 12-hydroxy	Lithium Complex	Polyurea	Sodium
Aluminum Complex	X	I	I	C	I	I	I	I	C	I	I
Barium	I	X	I	C	I	I	I	I	I	I	I
Calcium	I	I	X	C	I	C	C	B	C	I	I
Calcium 12-hydroxy	C	C	C	X	B	C	C	C	C	I	I
Calcium Complex	I	I	I	B	X	I	I	I	C	C	I
Bentone (Clay)	I	I	C	C	I	X	I	I	I	I	I
Lithium	I	I	C	C	I	I	X	C	C	I	I
Lithium 12-hydroxy	I	I	B	C	I	I	C	X	C	I	I
Lithium Complex	C	I	C	C	C	I	C	C	X	I	I
Polyurea	I	I	I	I	C	I	I	I	I	X	I
Sodium (Soda Base)	I	I	I	I	I	I	I	I	I	I	X

B - Borderline Compatibility
C - Compatible
I - Incompatible

INDUSTRIAL GREASES AND TYPICAL PROPERTIES

UNIREX EP

UNIREX EP is {premium, medium-base oil, lithium-complex-thickened lubricating grease for use in plain or anti-friction automotive and industrial bearings. This product is formulated in NLGI grades 1 and 2. Its formulation permits operation over a very wide temperature range. Both grades of UNIREX EP are shear and oxidation stable, protect

Copyright © 2000 The Fairmont Press, Inc.

against rust and corrosion and resist softening at elevated temperatures. UNIREX EP is specially formulated to resist the effects of water sprayoff and water washout. Both grades are also suitable for dispensing in long lines of centralized lubrication systems.

Table 9-4 highlights the properties of the two grades of grease. These are corroborated through rigorous testing, Figure 9-3.

Table 9-4. Inspection and test data UNIREX greases

	UNIREX EP 1	UNIREX EP 2
NLGI grade	1	2
Thickener type	Lithium-complex	Lithium-complex
Color	Green	Green
Texture	Smooth & homogenous	Smooth & homogenous
Penetration, ASTM D 217		
Worked 60X mm/10	320	280
Change, 100,000, mm/10	±20	±20
Dropping Point, ASTM D 2265		
°C(°F)	260+(500+)	260+(500+)
Base oil viscosity:		
cSt @ 40°C	220	220
cSt @ 100°C	17	17
SUS @ 100°F	1100	1100
SUS @ 210°F	95	95
Timken OK load, kg(lb)	27(60)	27(60)
Four-ball wear test, ASTM D 2265		
Scar diam., mm	0.45	0.41
Corrosion prevention test, ASTM D 1743	Pass	Pass
Oxidation life, ASTM D 942,		
Pressure drop 100 hours, kPa(psi)	35(5)	35(5)

RONEX Extra Duty

RONEX Extra Duty (Table 9-5) is a line of premium high-viscosity base-oil greases designed for heavy-duty applications such as those in paper and other rolling mills, construction and mining. Based on the proven lithium-complex thickener technology used in Exxon's RONEX MP multipurpose grease, RONEX Extra Duty greases have additives that provide higher load-carrying ability. This is partly due to the 2500 SUS viscosity of the base oil. They also offer excellent structural and oxidation stability and a high degree of water resistance.

Typical applications are paper machine wet end, press section and felt roll bearings, as well as multi-purpose lubrication—including couplings—in pulp and paper mills, construction and mining and other heavy industry.

RONEX Extra Duty is available in three grades: RONEX Extra Duty 1 and RONEX Extra Duty 2 (red NLGI Grade No. 1 and No. 2 greases) and RONEX Extra Duty Moly, a purple NLGI Grade No. 2 grease containing 3% molybdenum disulfide. All products are specially formulated with a tackiness additive to enhance retention on the lubricated part.

RONEX Extra Duty Moly is Exxon's primary recommendation for lubricating sliding and oscillating applications in off-road equipment such as fifth wheels and bucket pins.

Copyright © 2000 The Fairmont Press, Inc.

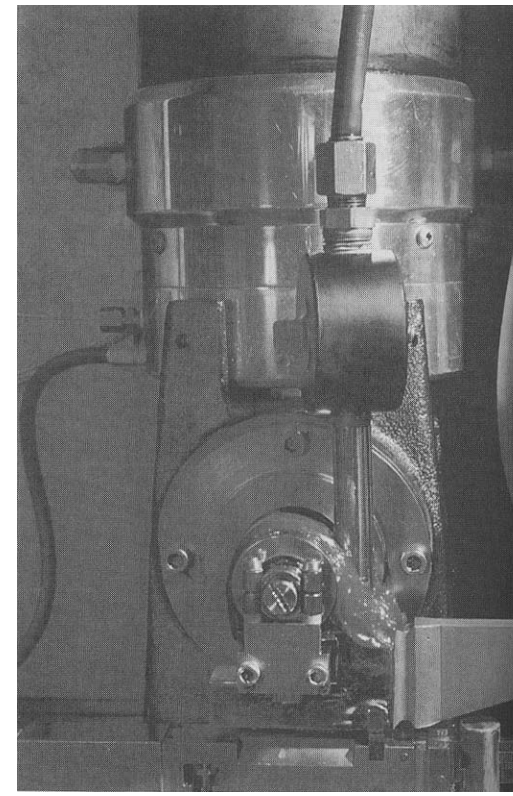

Figure 9-3. The Timken machine shown above simulates extreme pressure service conditions to measure the EP properties of lubricants.

Table 9-5. Inspection and test data for RONEX greases frequently used in paper mills.

NLGI Grade	RONEX Extra Duty 1	RONEX Extra Duty 2	RONEX Extra Duty Moly
NLGI grade	1	2	2
Thickener type	Lithium-complex	Lithium-Complex	Lithium-complex
Color	Red*	Red	Purple
Tackiness	Yes	Yes	Yes
Dropping point, ASTM D 2265 °C(°F)	260+(500+)	260+(500+)	260+(500+)
Base oil viscosity: SUS @ 100°F, ASTM D 2161	2500	2500	2500
Timken OK load, ASTM D 2509 kg(lb)	27(60)	27(60)	27(60)
Corrosion prevention test, ASTM D 1743	Pass	Pass	Pass
Molybdenum disulfide %	—	—	3

*Also available in an "undyed" version in some package styles.

Copyright © 2000 The Fairmont Press, Inc.

UNIREX RS 460 (Table 9-6)

UNIREX RS 460 grease contains a specially blended high-viscosity synthetic base oil in a lithium-complex thickener. It is recommended for applications in plants requiring high-viscosity lubricants with good mobility at low temperatures. It is specifically recommended for grease-lubricated dry-end felt rolls, wet-end process rolls and couplings, as well as for miscellaneous woodyard and mill-wide applications in paper mills. UNIREX RS 460 is extremely shear-stable and resists the effects of water and corrosive atmospheres.

Table 9-6. Synthetic grease for use in paper mills.

UNIRES RS 460	
NLGI grade	1-1/2
Thickener type	Lithium-complex
Color	Olive
Penetration, ASTM D 217, mm/10	
Worked, 60X	300
Worked, 10,000X	298
Worked, 100,000X	283
Dropping Point, ASTM D 2265, °C(°F)	260+(500+)
Oil type	Polyalphaolefin
Base oil viscosity:	
cSt at 40°C ASTM D 445	443
SUS @ 100°F, ASTM D 2161	2054
Timken OK load, ASTM D 2509, kg(lb)	23(50)
Four-ball EP test, ASTM D 2296	
Load wear index, kg	63
Weld point, kg	400
Four-ball wear test, ASTM 2266	
20 kg, 1800 rpm, 54°C(130°F), 1 hr, scar diam, mm	0.6
Corrosion prevention test, ASTM D 1743, modified	
5% synthetic sea water	Pass
Copper strip corrosion, ASTM D 4048	1B
Water washout, ASTM D 1264, % loss @ 79°C(175°F)	7.0
Lubrication life, ASTM D 3336, hrs @ 163°C(325°F)	600

POLYREX

POLYREX is a super-premium, high-temperature, polyurea grease recommended for all ball bearings and low-loaded roller bearings. It is an excellent alternative to UNIREX N at high temperatures. Long service life and superior structural stability at temperatures above 149°C(300°F) make POLYREX especially desirable in factory fill and sealed for-life applications. POLYREX grease's exceptional high-temperature performance was demonstrated in the ASTM D 3336 spindle test. It exhibited twice the life of any competitive polyurea grease (and of UNIREX N) at 177°C(350°F). (See Table 9-7.)

Copyright © 2000 The Fairmont Press, Inc.

Table 9-7. High-temperature synthetic grease inspection and test data.

POLYREX	
NLGI grade	1-1/2
Thickener type	Polyurea
Color	Tan
Penetration, ASTM D 217, mm/10	
Unworked	300
Worked, 60X	305
Worked, 100,000X	340
Dropping Point, ASTM D 2265, °C(°F)	304+(580+)
Base oil viscosity:	
cSt at 40°C, ASTM D 445	115.0
cSt at 100°C	12.2
SUS @ 100°F, ASTM D 2161	600.0
SUS @ 210°F	68.5
Four-ball EP test, ASTM D 2596	
Load wear index kg	32
Weld Point, kg	160
Four-ball wear test, ASTM D 2266	
40kg, 1200 rpm, 75°C(167°F), 1 hr, scar diam, mm	0.45
Corrosion prevention test, ASTM D 1743	Pass
Modified, 5% synthetic sea water, 24 hrs	Pass
Water washout, ASTM D 1264	
% loss @ 79°C(175°F)	2.4
Lubrication life, ASTM D 3336	
hrs @ 177°C(350°F)	500+
Wheel bearing leakage, ASTM D 1263	
90g pack @ 105°C(220°F), g	0.4
60g pack @ 163°C(325°F), g	0.1

POLYREX also performs well at -29°C(-20°F) and, where torque is not limiting, at temperatures as low as -40°C (-40°F). It exhibits exceptional structural stability, staying in grade even after extensive shearing. Other outstanding features include excellent anti-wear properties, water resistance and rust protection even in hot, corrosive marine environments. The reduced maintenance and extended lubrication intervals possible with this versatile, durable grease can be expected to reduce long-term lubrication costs.

Observe grease compatibility issues, mentioned earlier in this segment of our text.

UNIREX N

UNIREX N is the brand name for two premium-quality, multi-purpose greases suitable for long-life, high-temperature service in all types of bearings. These versatile greases have applications in a wide range of industries, including power plants. They are excellent for electric motors and most sealed-for-life bearings.

Copyright © 2000 The Fairmont Press, Inc.

UNIREX N greases have outstanding mechanical stability and excellent anti-wear properties. They have long lubrication life at recommended operating temperatures and are suitable for service down to -40°C(-40°F). They provide excellent rust protection, even in saline environments.

UNIREX N greases (Table 9-8) are available in two consistencies. UNIREX N 2 is an NLGI Grade No. 2. It is preferred for grease gun or hand-packing applications. UNIREX N 3 may be used in applications, such as vertical installations, which may require the higher consistency of the NLGI Grade No. 3.

Table 9-8. UNIREX N greases for electric motor bearings and similar applications.

	UNIREX N 2	UNIREX N 3
NLGI grade	2	3
Thickener type	Lithium-complex	Lithium-complex
Color	Green	Green
Penetration, ASTM D 217		
Worked, 60X	280	235
Worked, 100,000X, unit change	+5	+10
Dropping Point, ASTM D 2265,		
°C(°F)	260+ (500+)	260+ (500+)
Base oil viscosity:		
cSt at 40°C, ASTM D 445	115.0	115.0
cSt at 100°C	12.2	12.2
SUS @ 100°F, ASTM D 2161	600.0	600.0
SUS @ 210°F	68.5	68.5
Four-ball wear test, ASTM D 2266, scar diam, mm		
10 kg, 1800 rpm, 75°C(167°F), 1 hr	0.28	0.30
40 kg, 1200 rpm, 75°C(167°F), 1 hr	0.45	0.47
Corrosion prevention test		
ASTM D 1743	Pass	Pass
Modified 5% synthetic sea water 24 hrs	Pass	Pass
Lubrication life, ASTM D 3336		
Hrs @ 149°C(300°F)*	1000	1000
Hrs @ 163°C(325°F)*	500	500
Wheel bearing leakage, ASTM D 1263		
Modified, 60g pack @ 163°C(325°F), g	0.6	0.2
Oil separation, ASTM D 1742		
24 hrs @ 25°C(77°F),%	1.8	2.0

*Note: Lubrication life tests run on severe spindle rigs; data obtained on less severe rigs show up to 3,000 hrs lubrication life at 149°C(300°F).

Copyright © 2000 The Fairmont Press, Inc.

UNIREX® SHP Synthetic-Base-Oil Greases

UNIREX SHP is a line of five super-premium synthetic base-oil greases intended for severe, heavy-duty service in a variety of industrial and automotive applications. Formulated with a high-viscosity-index synthetic base oil, an Exxon-developed lithium-complex thickener and a unique additive package, UNIREX SHP greases are designed to provide extra protection and longer service life over a wider temperature range than mineral-base greases of comparable base oil viscosity.

The versatility of UNIREX SHP across a broad range of applications and operating environments may enable equipment operators to consolidate lubricants and reduce inventory costs—and its extra reliability in severe-service operations can reduce down-time and extend equipment life.

There are paper mill and related applications for UNIREX SHP grades 100, 460, and 1500. UNIREX SHP 220 is a multi-purpose lubricant, suitable for automotive wheel bearings and chassis requiring an NLGI GC/LB grease and for industrial applications where long life and extended maintenance intervals are desired. UNIREX SHP 00 is recommended as a gear oil replacement in truck trailer wheel bearings to protect against seal leaks; it is also recommended for leaking industrial gear boxes.

Typical inspections for these five super-premium, synthetic base-oil greases are given in Table 9-9.

UNIREX S 2

UNIREX S 2 (Table 9-10) is formulated with a high-viscosity, low-volatility synthetic (ester) base oil to provide excellent high-temperature lubrication where frequent relubrication is impractical. It compares favorably with the more expensive silicone greases in many applications, with the added advantage of superior lubrication under high bearing loads. Designed for use at operating temperatures in the 177°-204°C(350°-400°F) range, UNIREX S 2 can be used at higher temperatures with suitable relubrication intervals. It also has excellent low-temperature properties, providing starting and running torque at -40°C(-40°F) and, in many applications, acceptable torque at -54°C (-65°F). UNIREX S 2 has good water resistance.

Proven applications include conveyor bearings in kilns and ovens, steel mill ladle bearings, jet aircraft starter clutch assemblies and bearings atop ovens in fiberglass manufacture.

While the equipment manufacturer or grease manufacturer's representative should have the final word regarding compatibility of UNIREX S 2 in specific applications, the compatibility chart for diesters, Table 7-8, can be consulted.

EXXON HI-SPEED COUPLING GREASE

EXXON HI-SPEED COUPLING GREASE, Table 9-11, is a high-quality grease formulated to lubricate all flexible couplings. In particular, it meets the lubrication needs of couplings operating at high speeds and with high centrifugal forces. It provides extreme-pressure protection and is suitable for operating temperatures between -40°C(-40°F) and 149°C (300°F). EXXON HI-SPEED Coupling Grease offers excellent resistance to oil separation, as indicated by the ASTM D 4425 test results (K36 typically = 0/24).

Copyright © 2000 The Fairmont Press, Inc.

Table 9-9. Typical inspections for UNIREX SHP synthetic-based-oil greases.

Typical Inspections

The values shown here are representative of current production. Some are controlled by manufacturing specifications, while others are not. All may vary within modest ranges.

	UNIREX SHP 100	UNIREX SHP 220	UNIREX SHP 460	UNIREX SHP 1500	UNIREX SHP 00
NLGI Grade	2	2	1.5	1	00
Soap type	Lithium Complex	Lithium Complex	Lithium Complex	Lithium Complex	Lithium Complex
Base oil	Synthetic	Synthetic	Synthetic	Synthetic	Synthetic
Base oil viscosity, ASTM D 445 @ 408°C, cSt	100	220	460	1500	460
Color	Red	Red	Off-White	Red	Red
Dropping point, ASTM D 2265, °F	520	550	550	550	550
Penetration ASTM D 217 60X mm/10	280	290	300	325	400
Viscosity index, ASTM D 2270	143	154	161	154	161
Timken OK load, ASTM D 2509, lb	Non-EP	65	60	60	60
4 ball wear test, ASTM D 2266, mm	0.38	0.44	0.42	—	—
4 ball EP weld ASTM D 2596, kg	250	315	315	—	—
Water washout, ASTM D 1264, %	11	3	2	—	—
Mobility, U.S. Steel, grams/minute @ -18°C(0°F)	—	11.6	7.5	—	—
Lubrication life, ASTM D 3336 hours @ 350°F	300	—	300	—	—
Corrosion prevention with 10% sea water, EMCOR rating	1,2	0,0	0,1	—	—

Copyright © 2000 The Fairmont Press, Inc.

Table 9-10. UNIREX S @ grease formulated with synthetic ester-base oil for elevated load and temperature services.

UNIREX S 2	
NLGI grade	2
Thickener type	Lithium-complex
Color	Brown
Penetration, ASTM D 217	
Worked 60X mm/10	280
Worked 10 000X, unit change	+18
Dropping Point, ASTM D 2265, °C(°F)	260+ (500+)
Base oil viscosity, ASTM D 445	
cSt @ 40°C(SUS @ 100°F)	162(751)
cSt @ 100°C(SUS @ 210°F)	19.8(97.6)
Base oil viscosity index	160
Four-ball EP test, ASTM D 2596	
Load wear index, kg	31.4
Weld point, kg	160
Four-ball wear test, ASTM 2266, scar diam, mm	
10 kg, 1800 rpm, 75°C(167°F), 1 hr	0.53
40 kg, 1200 rpm, 75°C(167°F), 1 hr	0.68
Corrosion prevention test ASTM D 1743, distilled water	Pass
Water washout, ASTM D 1264, % loss @ 79°C(175°F)	0
Lubrication life, ASTM D 3336, 10,000 rpm	
Hrs @ 176°C(350°F)	1100

Table 9-11. Exxon high-speed coupling grease, typical inspections.

Exxon HI-SPEED Coupling Grease		
NLGI grade		1
Thickener type		Lithium-polymer
Color		Green
Penetration, ASTM D 217, mm/10	60X	336
	10,000X	370
Dropping Point, °C(°F), ASTM D 566		210(410)
Base oil viscosity, ASTM D 2161	SUS @ 100°F	2550
	SUS @ 100°F, after polymer addition	3300
	SUS @ 210°F	145
Base oil viscosity index, ASTM D 2270		85 min
Timken OK load, ASTM D 2509, kg (lb)		18(40)
Four-ball EP, ASTM D 2596	LWI, kg	51
	Weld point, kg	315
	Scar diam., mm	0.7
Corrosion prevention test, ASTM D 1743		Pass
Copper strip corrosion test, ASTM D 4048		lb
Centrifugal separation, ASTM D 4425	K36 = % oil separated/test hrs	K36=0/24

Copyright © 2000 The Fairmont Press, Inc.

LIDOK EP

LIDOK EP, Table 9-12, is a line of three multi-purpose EP greases and one EP semi-fluid grease. LIDOK EP greases meet the lubrication requirements of plain and anti-friction bearings, gears and couplings in general industrial applications. Properties include good water resistance, high-temperature performance, resistance to mechanical breakdown, excellent oxidation resistance, good rust protection and fortified extreme-pressure properties. LIDOK EP contains no lead or other heavy metals.

Semi-fluid LIDOK EP 000 is designed primarily for use in the gear cases of underground mining machinery, where leakage can be a problem. It stays in place and is easily pumpable. It meets all requirements of Specification 100-4 of the Lee-Norse Company and U.S. Steel Requirements No. 373.

LIDOK EP 2 Moly

LIDOK EP 2 Moly is a multi-purpose lithium-base grease recommended for automotive and industrial applications. It contains an extreme-pressure (EP) additive to increase the load-carrying properties of the grease. Additionally, it contains molybdenum disulfide which enhances the antifriction properties under boundary lubricating conditions. LIDOK EP 2 Moly is recommended for heavily loaded, sliding or oscillating applications, including off-highway applications, Figure 9-4 and Table 9-13.

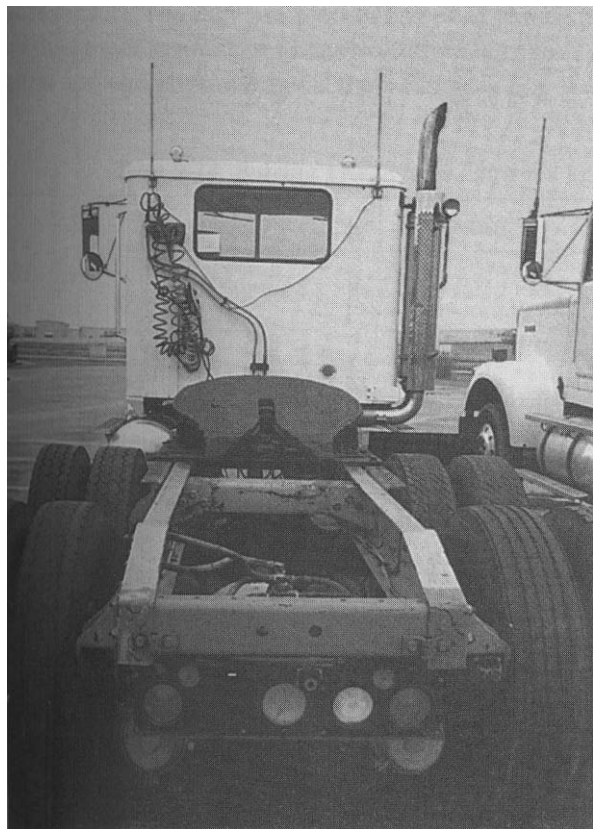

Figure 9-4. LIDOK EP 2 Moly is recommended for applications characterized by sliding or oscillating movements, such as the fifth wheel shown above.

Copyright © 2000 The Fairmont Press, Inc.

Table 9-12. LIDOK multi-purpose greases.

Grade	LIDOK EP 000	LIDOK EP 0	LIDOK EP 1	LIDOK EP 2
NLGI Grade	000	0	1	2
Thickener type	Lithium 12-OH	Lithium 12-OH	Lithium 12-OH	Lithium 12-OH
Color	Brown	Brown	Brown	Brown
Penetration, ASTM D 217				
Worked, 60X, mm/10	460	370	325	280
Worked 10 000X unit change	+12	+3	+4	+5
Dropping point, ASTM D 2265, °C(°F)	139(282)	171(340)	174(345)	177(350)
Base oil viscosity:				
cSt @ 40°C, ASTM D 445	310.0	150.0	150.0	150.0
cSt @ 100°C	19.0	12.8	12.8	12.8
SUS @ 100°F, ASTM D 2161	1600.0	800.0	800.0	800.0
SUS @ 210°F	97.0	70.8	70.8	70.8
Timken OK load, ASTM D 2509 kg(lb)	18(40)	18(40)	18(40)	18(40)
Four-ball EP test, ASTM D 2596				
Load wear index, kg	35	43	37	40
Weld Point, kg	250	250	250	250
Four-ball wear test, ASTM D 2266, scar diam, mm				
40 kg, 1200 rpm, 75°C(167°F), 1 hr	—	0.41	0.39	0.46
20 kg, 1800 rpm, 55°C(130°F), 1 hr	—	0.43	0.42	0.39
75 kg, 1800 rpm, 55°C(130°F), 1 hr	0.31	—	—	—
Corrosion prevention test, ASTM D 1743	Pass	Pass	Pass	Pass
Water washout, ASTM D 1264				
% loss @ 38°C(100°F)	—	10	7	3
% loss @ 79°C(175°F)	—	20	15	6
Wheel bearing leakage, ASTM D 1263, 104°C(220°F), g	—	—	5	0
Oil Separation, ASTM D 1742, %	*	*	4	3

*Grease passes through screen without separation

Copyright © 2000 The Fairmont Press, Inc.

Table 9-13. Typical inspections for lithium-base grease containing molybdenum.

LIDOK EP 2 Moly	
NLGI Grade	
Thickener type	Lithium 12-OH
Color	Dark gray
Texture	Smooth & buttery
Penetration, ASTM D 217 worked, 60X, mm/10280	
Dropping Point, ASTM D 2265, °C(°F)	175(347)
Base oil viscosity, ASTM D 445, cSt at 40°C	150
Timken OK load, kg(lb)	18 (40)
Water washout, ASTM D 1264, % loss @ 79°C(175°F)	6
Wheel bearing leakage, ASTM D 1263 104°C(220°F), g	0
Oil separation test, ASTM D 1742, %	3
Corrosion prevention test, ASTM D 1743	Pass

ANDOK B, C and 260 (Table 9-14)

ANDOK greases are specially formulated to provide exceptional service in rolling-contact bearings subjected to severe operating conditions. They have excellent oxidation resistance and protect against rust in damp locations. They also have excellent channeling characteristics, i.e., they are readily forced to the bearing sides during operation, leaving just the proper amount of grease to lubricate rolling elements. This significantly reduces torque and temperature rise in the bearing.

Table 9-14. Bearing grease formulated for moderate duty applications.

	ANDOK B	ANDOK C	ANDOK 260
NLGI grade	2	4	3
Thickener type	Sodium-complex	Sodium-complex	Sodium-complex
Color	Brown	Brown	Brown
Penetration, ASTM D 217, mm/10			
Unworked	270	180	260
Worked, 60X	285	205	260
Dropping Point, ASTM D 2265			
°C(°F)	245(475)	260(500)	190(375)
Base oil viscosity:			
cSt @ 40°C, ASTM D 445	59.2	93.0	105
cSt @ 100°C	6.2	8.8	11.1
SUS@ 100°F, ASTM D 2161	310.0	510.0	550.0
SUS @ 210°F	48.0	56.0	64.0
Lubrication life, ASTM 3336			
Hrs @ 120°F (250°F)	1500	1500	5000+
Hrs @ 150°F (300°F)	400	400	1000
Oxidation life, ASTM D 942			
ΔP after 500 hours, kPa(psi)	105(15)	105(15)	35(5)

Copyright © 2000 The Fairmont Press, Inc.

Applications of ANDOK B include sealed-for-life bearings, high-speed bearings and bearings operating at high temperatures. It is also used in both ball and roller bearings, particularly for factory/field replenishment by grease gun.

ANDOK C is used for factory fill of ball bearings and hand-packed replenishment in the field.

ANDOK 260 is an extra-long-life grease suitable for ball bearings *and* roller bearings.

BEACON P 290 AND 325 (Table 9-15)

BEACON is the brand name for two greases formulated for the lubrication of precision equipment at moderate and low temperatures. Both are made with base oils of extremely low viscosity. They are characterized by low starting and running torque at very cold temperatures. Both offer maximum lubrication protection to small gears, plain and anti-friction bearings and other parts of fine instruments, control mechanisms, small motors and generators.

Table 9-15. Typical grease used for instrument bearings and similar low-torque applications.

	BEACON P 290	BEACON 325
NLGI grade	1-1/2	2
Thickener type	Lithium	Lithium
Color	Tan	Light tan
Penetration, ASTM D 217		
worked, 60X mm/10	300	280
Dropping Point, ASTM D 2265,		
°C(°F)	160(320)	195(384)
Oil type	Mineral	Diester
Base oil viscosity:		
cSt @ 40°C, ASTM D 445	14.2	11.8
cSt @ 100°C	3.2	3.3
SUS @ 100°F ASTM D 2161	79.0	67.7
SUS @ 210°F	36.9	37.2
Water washout, ASTM D 1264		
% loss @ 79°C(175°F)	—	1.0
Oil separation, ASTM D 1742		
24 hrs @ 25°C(77°F), %	4.9	4.0

BEACON P 290 is a lithium-soap, petroleum-base grease used in arctic environments to lubricate bearings in power tools, valve operator and similar instruments. It is formulated to be used at temperatures below -54°C(-65°F).

BEACON 325 is a lithium-soap, synthetic-oil-base grease. This makes it suitable over a wider temperature range—from as low as -54°C(-65°F) to as high as 120°C(250°F).

NEBULA EP (Table 9-16)

NEBULA EP is suitable for plain and anti-friction bearings—at high or low temperatures, high or low speeds, under heavy or light loading and wet or dry conditions. Its properties include anti-wear and EP protection, resistance to softening at high temperatures, water-resistance and good adhesion.

Copyright © 2000 The Fairmont Press, Inc.

Table 9-16. NEBULA greases are primarily applied in centralized systems and wet environments.

	NEBULA EP 000	NEBULA EP 0	NEBULA EP 1	NEBULA EP 2
NLGI	000	0	1	2
Thickener type	Calcium-complex	Calcium-complex	Calcium-complex	Calcium-complex
Color	Light tan	Dark tan	Dark tan	Dark tan
Penetration, ASTM D 217				
Worked, 60X, mm/10	415	370	325	280
Worked, 10,000X, unit change	NA	±5	±5	±5
Dropping point, ASTM D 2265, °C(°F)	260+ (500+)	260+(500+)	260+(500+)	260+(500+)
Oil type	PAO	Mineral oil	Mineral oil	Mineral Oil
Base oil viscosity:				
cSt @ 40°C, ASTM D 445	97 0	96.3	96.3	96.3
cSt @ 100°C	14.1	8.3	8.3	8.3
SUS@ 100°F, ASTM D 2161	590.0	510.0	510.0	510.0
SUS @ 210°F	84.8	56.0	56.0	56.0
Timken OK load, ASTM D 2509				
kg(lb)	18(40)	21(45)	21(45)	21(45)
Four-ball EP test, ASTM D 2596				
Load wear index, kg	44	50	54	63
Weld Point, kg	250	200	315	315
Four-ball wear test, ASTM D 2266				
40 kg, 1200 rpm, 75°C(167°F), 1 hr, scar diam, mm	0.4	0.67	0.67	0.67
Corrosion prevention test, ASTM D 1743	Pass	Pass	Pass	Pass
Water washout, ASTM D 1264				
% loss @ 79°C(175°F)	NA	2	2	1

Copyright © 2000 The Fairmont Press, Inc.

NEBULA EP 00 AND EP 0 have been used extensively in control valves in powerplants. NEBULA EP 0 is a soft grease for easier dispensing at low temperatures and may be used in all types of centralized systems. NEBULA EP 1 has the consistency characteristics that meet most requirements. It is recommended for all grease gun applications. NEBULA EP 2 exhibits excellent resistance to washout. It is recommended for wet applications, where fast-moving streams of water may dislodge a soft grease or where very high temperatures are a concern. NEBULA EP 1 and EP 2 should not be used in centralized lubricating systems.

RONEX MP

Although not an "industrial" grease in the true sense of the term, this versatile, premium NLGI Grade No. 2 multi-purpose grease has a wide range of automotive and industrial applications. It combines high-temperature performance with extreme-pressure properties, plus good water resistance, excellent oxidation stability, rust protection and resistance to chemical breakdown.

RONEX MP withstands the high temperatures of severe disc braking and provides extended trouble-free lubrication. It has passed the severe ASTM D 3428 Ball Joint Test, which evaluates a grease's ability to provide minimum wear, minimum torque and protection against water contamination.

In industrial uses, RONEX MP is recommended for all types of bearings, gears and couplings where a multi-purpose, water-resistant EP grease is applicable.

RONEX MP meets or exceeds the requirements of the Mack MG-C extended lubrication internal specification, GM's specification 6031-M for chassis and wheel bearing lubrication, and NLGI GC-LB for chassis and wheel bearing lubrication as defined by ASTM D 4950. It also may be used in electric motors of NEMA (National Electric Manufacturers' Association) Insulation Class A & B types. Table 9-17 gives some of the more important characteristics of this grease.

LIDOK CG Moly (Table 9-18)

LIDOK CG Moly, *specially formulated as an automotive chassis grease*, has been tested and approved by Ford Motor Company for use under their Type M1C75B specification. It also meets the requirements of GM's specification 6031M. LIDOK CG Moly contains 4% polyethylene and 1% molybdenum disulfide.

ROLUBRICANT 1 and 2 (Table 9-19)

ROLUBRICANT 1 and 2 are lithium-base greases with extreme-pressure properties. They meet U.S. Steel Requirements 370 and 375. Specifically designed to meet the demanding needs of steel mills, ROLUBRICANT 1 and 2 resist water washout at medium-to-high operating temperatures. Both grades are suitable for centralized lubrication systems, although attention must be given to ROLUBRICANT 2 at low temperatures. As indicated in Figure 9-5, these greases excel by resisting water washout at high temperatures.

FOODREX FG 1 Grease

Covered earlier in this text (see Table 6-5), FOODREX FG 1 Grease is a premium grease specially formulated to meet the demands of the food and beverage industry. It is white

Copyright © 2000 The Fairmont Press, Inc.

Table 9-17. Multi-purpose, water-resistant EP grease, typical inspections.

RONEX MP		
NLGI grade		2
Thickener type		Lithium-complex
Color		Dark green
Penetration, ASTM D 217,	Worked, 60X, mm/10	285
	Worked, 100,000X, unit change	+ 10
Dropping point, ASTM D 2265, °C(°F)		260+(500+)
Base oil viscosity:	cSt at 40°C, ASTM D 445	146
	cSt at 100°C	14
	SUS @ 100°F, ASTM D 2161	767
	SUS @ 210°F	75
Timken OK load ASTM D 2509 kg(lb)		18(40)
Four-ball EP test, ASTM D 2596,	Load wear index, kg	40
	Weld point kg	250
Four-ball wear test, ASTM D 2266		
40 kg, 1200 rpm, 75°C(167°F), 1 hr, scar diam, mm		0.40
Corrosion prevention test ASTM D 1743		Pass
Water washout ASTM D 1264, % loss @ 79°C(175°F)		4
Lubrication life, ASTM D 3336, hrs @ 163°C(325°F)		125
Wheel bearing leakage, ASTM D 1263 modified		
60g pack @ 163°C(325°F), g		1.5
Oil separation, ASTM D 1742, 24 hrs @ 25°C(77°F), %		3

in color and has a smooth-tacky appearance. FOODREX FG 1 Grease is an NLGI 1 grade consistency and contains an extreme-pressure additive for carrying heavy loads. All components of FOODREX FG 1 Grease are permitted under the U.S. Food and Drug Administration (FDA) Regulation 21 CFR 178.3570, "Lubricants With Incidental Food Contact." All components of Foodrex FG 1 Grease are acceptable to the U.S. Department of Agriculture for use as a lubricant with incidental food contact in establishments operating under the meat and poultry products inspection program. It is approved as a category "H-l" compound in the USDA list of Chemical Compounds. Additionally, FOODREX FG 1 Grease is Kosher and Pareve-certified.

CARUM 330

The typical inspections for CARUM 330 were given earlier in Table 6-6. This specially formulated grease is primarily used for lubricating food and beverage-processing machinery. It is highly resistant to water, steam, vegetable and fruit juices and carbonated beverages. CARUM 330 contains a rust inhibitor and has good high-temperature and wear-preventive properties. Manufactured with a calcium-complex soap base, it offers the wear protection and load-carrying capacity that is characteristic of such greases.

All of the ingredients in CARUM 330 are permitted under FDA Regulations 21 CFR 178.3570, "Lubricants With Incidental Food Contact." CARUM 330 is acceptable to the

Copyright © 2000 The Fairmont Press, Inc.

Table 9-18. Specially formulated automotive chassis grease.

LIDOK CG Moly	
NLGI grade	2
Thickener type	Lithium 12-OH
Appearance/texture	Dark gray/butttery
Base oil type	Mineral oil
Dropping point, ASTM D 2265, °C	187
Penetration, ASTM D 217, 60X, mm/10	285
Penetration change, ASTM D 217, 10,000X, %	12
Four-ball EP test, ASTM D 2596, kg	
LWI	42.6
Weld point	250
Four-ball wear test, ASTM D 2266, 10 kg, 1800 rpm	
75°C. 1 hr, scar diam., mm	0.37
Base oil viscosity, ASTM D 2161	
@ 100°F	800
@ 210°F	80.2
Base oil viscosity index, ASTM D 2270	90
Wheel bearing leakage, ASTM D 1263, modified, gm @ 325°F	2.1
Water washout, ASTM D 1264 % @ 175°F	4
Oil separation, ASTM D 1742 modified, ml	10
Oxidation stability, ASTM D 942, psi drop	
100 hrs	3
1000 hrs	27
Rust protection, ASTM D 1743	Pass (1,1,1)
Ball joint test, ASTM D 3428	Pass

USDA and is authorized for use as a lubricant with incidental food contact in establishments operating under the meat and poultry products inspection program. It is listed as a category "H1" compound in the USDA List of Chemical Compounds.

FIREXX Grease 1 and 2 (Table 9-20)

FIREXX Grease 1 AND 2 are flame-retardant, aluminum complex greases, Figure 9-6. They are excellent general-purpose greases that are highly resistant to combustion, providing additional time for plant personnel to respond to a potential fire. They are especially suitable for steel mills, underground railways, mines, welding areas or anywhere there is a need to minimize potential fire hazards. Both grades are adhesive and provide good high-temperature performance, rust and corrosion protection and excellent load-carrying capability and water resistance.

DYNAGEAR

DYNAGEAR (Table 9-21) represents an open gear lubricant that is formulated for cold temperature dispensability without the use of chlorinated solvents or petroleum solvents. It offers an environmentally responsible lubricant for open gear applications (see Figure 9-7). DYNAGEAR can be dispensed down to -20°C(-4°F).

Copyright © 2000 The Fairmont Press, Inc.

Table 9-19. Typical inspections for "ROLUBRICANT" grease used in steel plants.

	ROLUBRICANT 1	ROLUBRICANT 2
NLGI grade	1-1/2	2-1/2
Thickener type	Lithium 12-OH	Lithium 12-OH
Color	Black	Black
Penetration, ASTM D 217		
Worked, 60X, mm/10	300	265
Dropping Point, ASTM D 2265, °C(°F)	182(360)	186(366)
Base oil viscosity, ASTM D 2161		
SUS @ 100°F	1050	1200
SUS @ 210°F	74	83
Timken OK load, ASTM D 2509, kg(lb)	18(40)	18(40)
Four-ball EP test, ASTM D 2596		
Load wear index, kg	40	40
Weld point, kg	315	315
Four-ball wear test, ASTM D 2266		
20 kg, 1800 rpm, 54°C(130°F), 1 hr		
scar diam, mm	0.4	0.4
Corrosion prevention test, ASTM D 1743	Pass	Pass
Water washout, ASTM D 1264		
% loss @ 79°C(175°F)	4	3
Water sprayoff, ASTM D 4049		
276 kPa(psi), 38°C(100°F), % loss	10	3
Oxidation stability, ASTM D 942		
AP after 100 hours, kPa(psi)	42(6)	42(6)
Wheel bearing leakage, ASTM D 1263, %	3.2	0.7
Mobility, USS method		
Flow rate @ -18°C(0°F), g/min	5	1

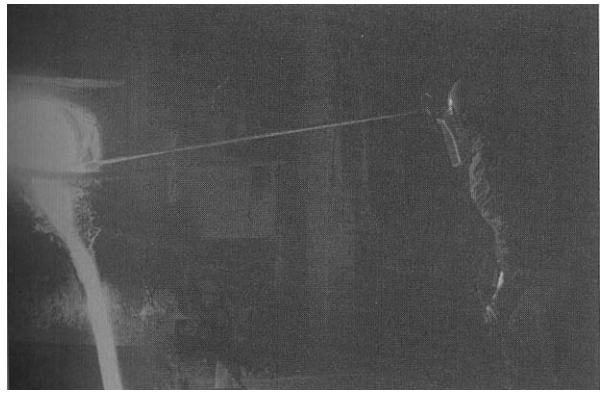

Figure 9-5. ROLUBRICANT 1 and 2 tenaciously resist water washout at high operating temperatures. This ideally suits them for use in the high-pressure, super-heated environments of steel mills. (Photo courtesy of Quamex Corporation.)

Copyright © 2000 The Fairmont Press, Inc.

Table 9-20. Fire-retardant, aluminum complex greases.

	FIREXX Grease 1	FIREXX Grease 2
NLGI grade	1	2
Color	Black	Black
Texture	Buttery	Buttery
Thickener type	Aluminum-complex	Aluminum-complex
Penetration, ASTM D 217		
Worked, 60X, mm/10	320	280
Dropping Point, ASTM D 2265,°C(°F)	212(415)	212(415)
Base oil viscosity:		
SUS @ 100°F, ASTM D 2161	1500	1500
Timken OK load, ASTM D 2509, kg(lb)	18(40)	18(40)
Four-ball EP test, ASTM D 2596		
Load wear index, kg	40	40
Weld point, kg	315	315
Four-ball wear test, ASTM D 2266		
40kg, 1200 rpm, 75°C(167°F)		
1 hr, scar diam, mm	0.45	0.45
Corrosion prevention test, ASTM D 1743	Pass	Pass
Water sprayoff, ASTM D 4049, % loss	15	6
Wheel bearing leakage, ASTM D 1263		
104°C(220°F), g	—	3.0
Mobility, USS method		
Flow rate @ -18°C(0°F) g/min	3	—

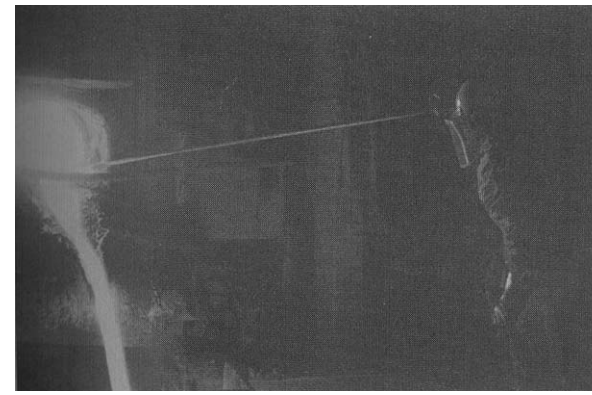

Figure 9-6. This demonstration dramatically illustrates the flame-retardant capabilities of FIREXX Grease (center) compared with two conventional greases (lithium complex and aluminum complex, respectively). The FIREXX Grease sample resisted ignition and, once lit, extinguished itself within seconds. The photograph was taken approximately 20 seconds after igniting the conventional greases and 12 seconds after igniting the FIREXX Grease.

Copyright © 2000 The Fairmont Press, Inc.

Table 9-21. Inspection and test data for DYNAGEAR *open gear lubricant.*

DYNAGEAR	
NLGI Grade	0
Thickener type	Lithium 12-OH
Base oil viscosity, ASTM D 445, cSt at 40°C	1000
Viscosity as applied, cp @ 100°C	40,000
Timken OK load, kg(lb)	28(60)
Four-ball EP test,	
Weld point, kg	800
Load wear index	140
Operating temperature range, °C(°F)	-40(-40) to +100(212)
Minimum dispensing temperature, °C(°F)	-20(-4)

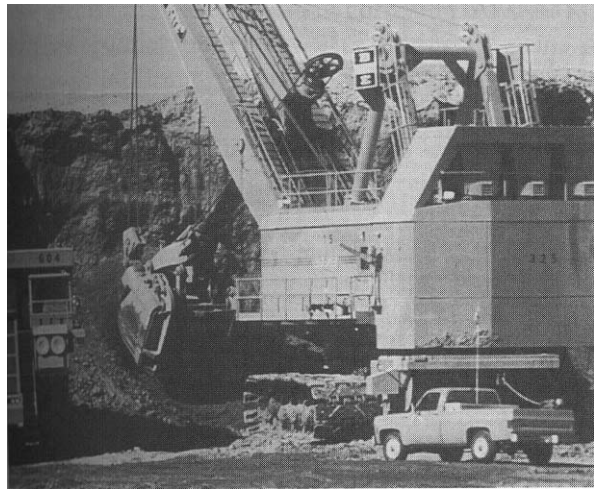

Figure 9-7. Extensively field tested in equipment such as this, DYNAGEAR *offers significant advantages over conventional asphalt-base products.*

DYNAGEAR provides a tenacious lubricant film that firmly adheres to lubricant surfaces. The formulation is solvent-free; thus, run-off is less than for those formulations that contain solvents. This open gear lubricant is formulated with excellent anti-rust, anti-corrosion and oxidation protection properties. Powerful solid lubricants, graphite and molybdenum disulfide, are added to assist the load-carrying capability even at very low speeds. DYNAGEAR offers exceptional water resistance. Moderate amounts of water can be absorbed by these products with minimal effect on the NLGI consistency grade. Because the base oil used in DYNAGEAR does not contain asphalt, excessive lubricant build-up on gears and gear tooth roots is rare. This contributes to faster clean-up and reduces the likelihood of misalignment problems. Because the formulation does not contain solvents, flammability is equivalent to any other mineral-oil-base lubricant. Recommended operating and dispensing temperatures are shown in Table 9-21.

Copyright © 2000 The Fairmont Press, Inc.

ARAPEN RB 320 (Table 9-22)

ARAPEN RB 320 is a elong-life grease developed for the roller bearings of railroad car journals where no provision is made for in-service relubrication. It is fully approved against AAR Specifications M-942-88 for Journal Roller Bearing Grease for non-field-lubricated bearing applications.

Table 9-22. Long-life grease formulated for railroad car journals.

	ARAPEN RB 320	AAR M-942-88 Requirements
Thickener type	Calcium-lithium	—
Penetration, ASTM D 217		
Worked, 60X, mm/10	305	290-320
Worked, 100,000X, mm/10	+18	+25
Dropping Point, ASTM D 2265, °C(°F)	177(350)	163(325)
Base oil viscosity, ASTM D 2161		
SUS @ 100°F	840	750 min
Base oil viscosity index	100	80 min
Base oil flash point (open cup) °C(°F)	246(475)	171(340) min
Corrosion prevention test ASTM D 1743	Pass	Pass
Oxidation stability, ASTM D 942		
AP after 100 hours, kPa(psi)	1	10 max
AP after 500 hours, kPa(psi)	5	25 max
AAR elevated temperature roll stability, Penetration @ 82°C(180°F)		
Worked, mm/10	325	290-340
Dynamic mechanical stability		
Migration and distribution	1	1 or 2
Penetration after test, mm/10	307	280-320
Moisture, ASTM D 128, %	nil	0.10 max

ARAPEN RB 320 has high oxidation stability. It is resistant to heat and to deterioration in the presence of water and chemicals. It is also inhibited to give protection against rust ARAPEN RB 320 will retain its consistency after prolonged working—as in the churning action of an antifriction bearing (see Figure 9-8). It has little effect on elastomeric seal materials, and thus maintains good seal performance—a significant requirement for shop-to-shop wheel service.

ARAPEN RB 320 is used as the factory-fill lubricant by major manufacturers of railroad journal bearings.

Copyright © 2000 The Fairmont Press, Inc.

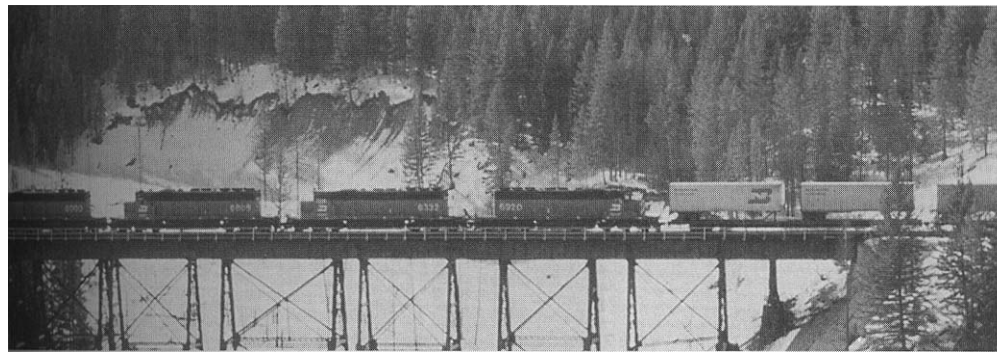

Figure 9-8. ARAPEN RB 320 is exceptionally resistant to shear, i.e., it retains consistency after prolonged working and is dependable over long hauls.

ARAPEN RC 1 (Table 9-23)

ARAPEN RC 1 rail-flange grease is designed for use in onboard lubricators. ARAPEN RC 1 has also been successfully used in wayside lubricators. It has excellent water resistance and is inhibited to prevent corrosion. ARAPEN RC 1 is fortified with 3% moly, which provides residual lubrication. The product contains polymers that provide excellent adherence to lubricating surfaces and enhance track carry-down. The superior anti-wear characteristics of ARAPEN RC 1, compared with several competitive products, have been demonstrated in the Timken retention test, four-ball test and SRV. Figure 9-9 comments on the environmental impact of this railroad grease.

Table 9-23. Rail-flange grease used to reduce wheel wear and noise.

ARAPEN RC 1	
NLGI grade	1
Thickener type	Lithium 12-OH
Tackiness	Yes
Penetration, ASTM D 217	
Worked, 60X, mm/10	325
Dropping Point, ASTM D 2265, °C(°F)	191 (375)
Base oil viscosity, ASTM D 2161	
SUS @ 100°F	500
Four-ball wear test, ASTM D 2266	
10 kg, 1800 rpm, 75°C(167°F), 1 hr, scar diam, mm	0.46
Timken retention test	
Scar diam	<1
Weight loss, mg	nil
Load, lb	25
Molybdenum disulfide, %	3

Copyright © 2000 The Fairmont Press, Inc.

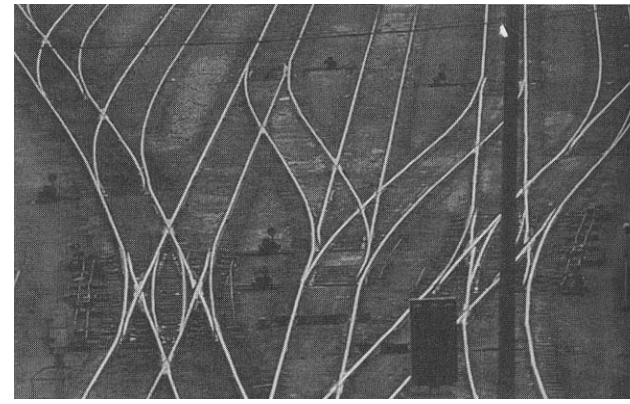

Figure 9-9. In addition to being an excellent anti-wear rail-flange grease, ARAPEN RC 1 poses minimal threat to the environment. These findings are the result of an extensive environmental impact program voluntarily undertaken by Exxon.

References

1. Kusnier, Walter J., "Mixing Incompatible Greases," *Plant Services*, June 1997, pp. 143–149.
2. Bloch, H.P., and Rizo, L.F., "Lubrication Strategies for Electric Motor Bearings in the Petrochemical and Refining Industries," presented at the NPRA Maintenance Conference, San Antonio, Texas, February, 1984.

Copyright © 2000 The Fairmont Press, Inc.